Space Weather Technical Forecast

Issued on Sunday, 15 May 2022 at 13:01 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: R1-R2 radio blackouts becoming increasingly Likely. Slight Chance of G1/Minor Geomagnetic Storm, mainly day 1.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the past 24 hours, with an isolated M2.2 flare at 15/0008 UTC from an active region beyond the northeast limb. There are five numbered and two un-numbered sunspots on the visible disc. AR3007 continues as the largest and most complex region, with the formerly large intermediate spot having separated, along with some other intermediate spot decay/emergence. AR3006 continues to show slight decay, consisting of a few small, weak spots. AR3013 has weakened to just a few very small spots. AR3011 is unchanged as a stable Bxo in the northeast, and AR3010 in the southeast is more complex, with some intermediate spot emergence. Two as yet un-numbered regions towards the northeast limb are currently assessed as C-types, with the northernmost region showing slight growth. There remain numerous small filaments on the disc.

A large prominence eruption occurred from the southeast around 14/1800UTC, with this event visible in coronagraphs but directed below the ecliptic plane. This has been modelled with no effect indicated at Earth. No other Earth directed Coronal Mass Ejections (CMEs) have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, showed an increase during the evening UTC of 14th, from around 370km/s, to a current levelling out at around 570km/s. This is now thought to be the earlier than anticipated arrival of the coronal hole high speed stream. The IMF was often at moderate strength, with a peak of 21nT on the evening UTC of 14th. A slow, erratic settling was observed thereafter to near 10nT. The north-south component showed fluctuating periods of north/south orientation, peaks between +15 and -9nT, with the longest period of southward orientation between midnight UTC and 15/0300 UTC. The phi angle was mostly positive (away from the Sun), with a few brief negative (towards the Sun) switches. The net effect of these solar wind measures was mostly Quiet to Unsettled (Kp 1 to 3) conditions, but with Active (Kp 4) periods observed between 15/0000-0600 UTC by NOAA SWPC and Potsdam.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours.

The high energy electron flux (greater than 2 MeV) has remained predominantly at Normal Background levels, with the corresponding electron fluence well below the Active (1e8 integrated pfu) threshold on a current level trend. Observed fluence at 15/0001 UTC was 1.18e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity should be Low to Moderate, with M-class flares becoming slightly

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more Likely, and a Slight Chance of an X-class flare. The flare risk may trend a little higher through the period owing to potentially further active regions rotating around the northeast limb.

Solar Wind / Geomagnetic Activity: No CMEs currently feature in the forecast.

The current elevated solar winds now appear to indicate the earlier than anticipated arrival of the high speed stream from positive polarity CH81/+, bringing forward a Slight Chance of Minor Geomagnetic Storm G1, with the main chance now thought to be on day 1 before decreasing through the period. This was the only expected enhancement of the solar wind due in the four day period, and an increasingly Quiet outlook is therefore expected as the forecast period progresses.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at background levels during this period, although there is slight risk of an S1 or greater event, mainly due to AR3007 as it transits west from a central location.

The high energy electron flux (greater than 2 MeV) is forecast to remain at Normal Background to Moderate levels at first, but may rise over the next few days, with an increased chance of the diurnal peak reaching High levels. The 24-hour electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold during the forecast period, but with a likely rising trend.

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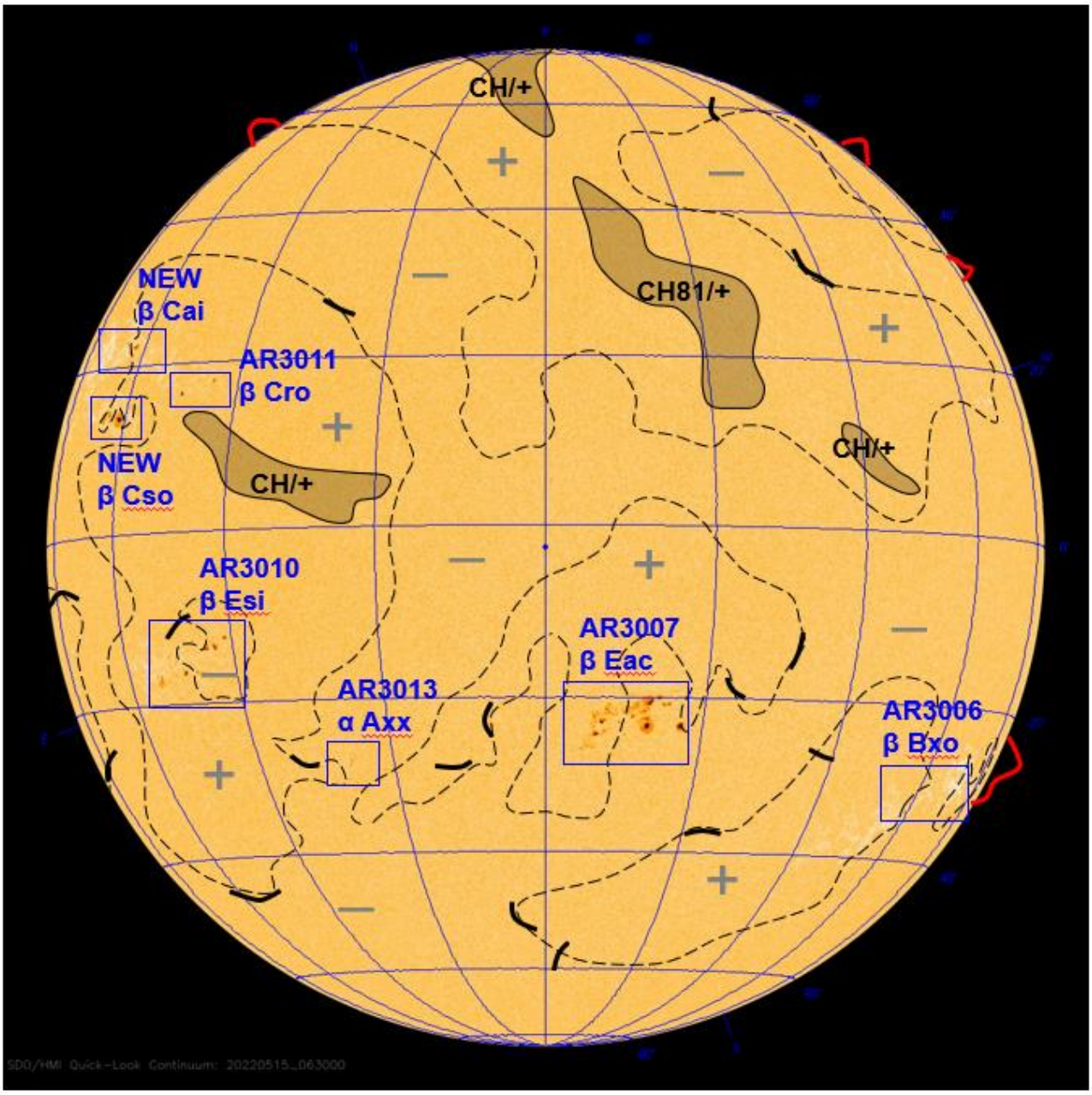
Figure 1. Solar Analysis Valid 15/0700 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-bound Coronal Mass Ejections (CMEs) currently feature in this forecast period.
Solar winds in the past 24 hours now appear to indicate the earlier than anticipated arrival of the high speed stream from positive polarity coronal hole 81. In hindsight, there are suggestions of similar influence from STEREO A MAG and PLASTIC traces around 2.5 days upstream of Earth in the Parker spiral. Relative to earlier guidance, the risk of Minor Geomagnetic Storms is therefore brought forward slightly, with the main chance now thought to be on day 1 before decreasing through the period.

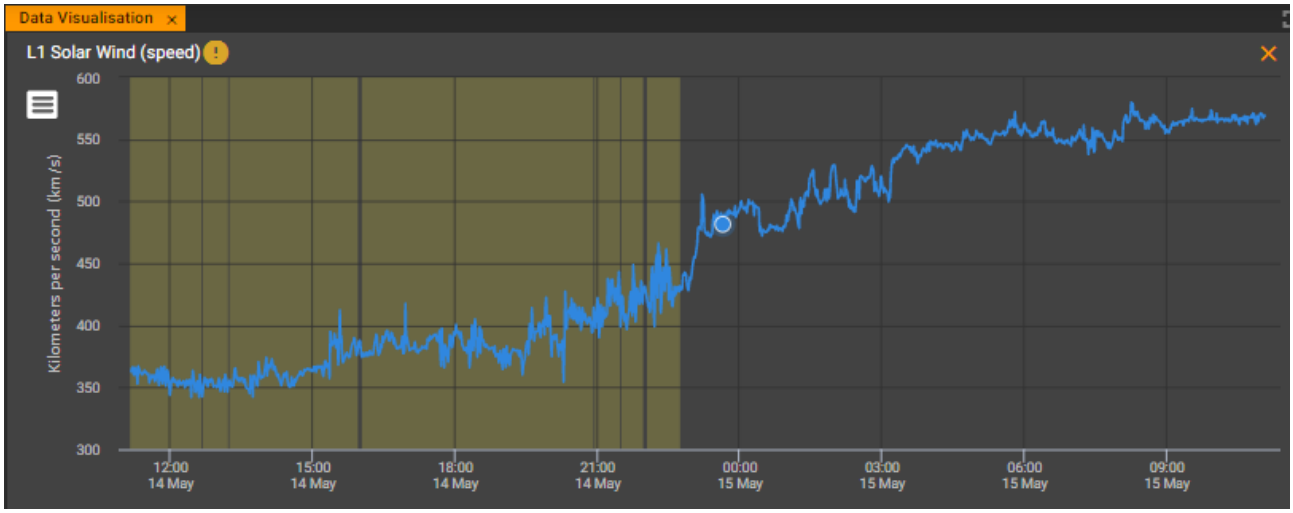
This was the only expected enhancement of the solar wind due in the four day period, and an increasingly Quiet outlook is therefore expected as the forecast period progresses.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

None currently expected.

Figure 2: Solar wind speeds from the ACE (lighter background shading)/DSCOVR satellites.



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Radio Blackouts - X-Ray Flares:

The Earth facing side of the solar disc is expected to see an increase in the number of sunspot regions in the period, as potentially further active regions rotate around the northeast limb into the coming UTC working week. The exact contribution from these is uncertain, but they are likely to more than compensate for the loss of AR3006 early in the period, with this group fading in any case.

Therefore, there is a slightly increasing risk of M-class flares, with a similar slight increase in the probability of isolated X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	60	60	60
Very Active	R3 to R5 X Class	No	5	10	10	10

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is close to Background levels and is generally expected to remain at that level throughout the period. However, there is a slight chance of an S1 or greater event during the forecast period, primarily due to the presence of AR3006 in the southwest quarter, and AR3007 as it transits west from a central location.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	10	10	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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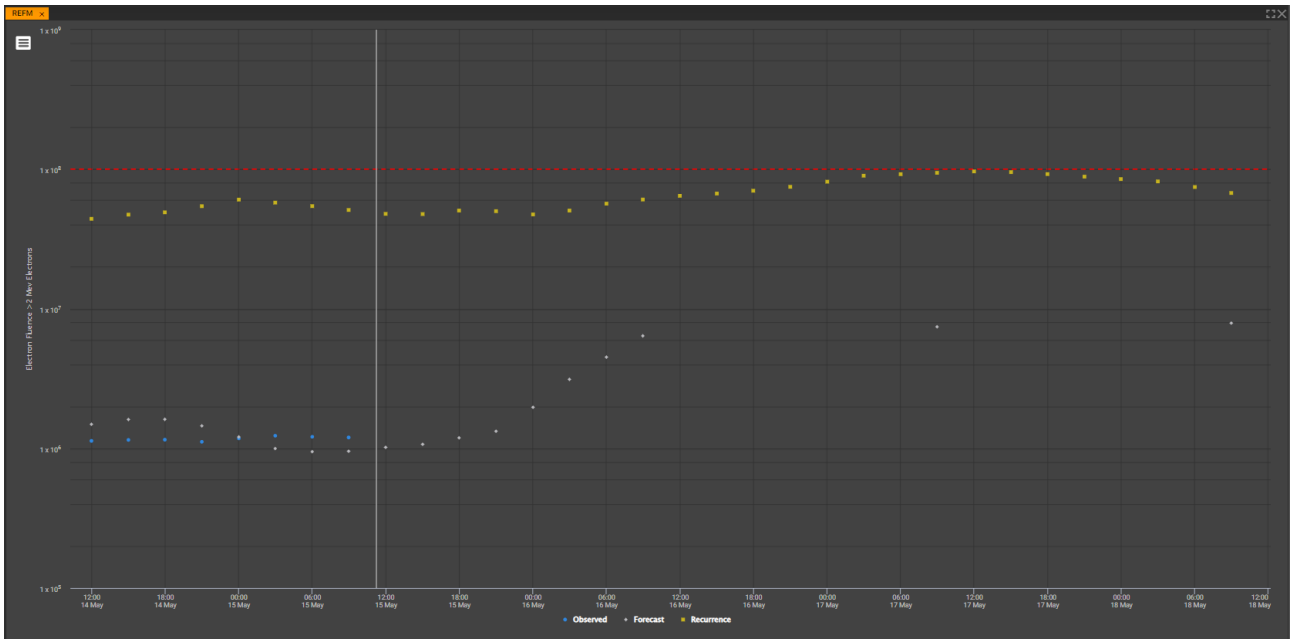
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) is currently at Normal background to Moderate levels, but may rise over the next few days due to high speed stream influence from CH81/+ , which arrived earlier than anticipated.

The corresponding electron fluence is therefore expected to show an upward trend through the period, however on balance will most likely continue below the Active (1e8 integrated pfu) threshold. This is reflected by current REFM output.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	10	20	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: MOSWOC REFM output. (*Yellow data points – recurrence values* , white – *REFM forecast, blue – observed fluence)*



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